

The underlying PCT Application No. PCT/DE00/02023 includes an International Search Report, dated October 27, 2000. The Search Report includes a list of documents that were uncovered in the underlying PCT Application. A copy of the Search Report accompanies this Preliminary Amendment.

The underlying PCT application also includes an International Preliminary Examination Report, dated August 13, 2001. An English translation of the International Preliminary Examination Report accompanies this Preliminary Amendment.

Applicants assert that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully Submitted,

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METHOD FOR THE SELECTIVE COATING OF CERAMIC SURFACE AREAS

FIELD OF THE INVENTION

The present invention relates to a method for treating the surface of a ceramic hybrid substrate [having] including ceramic surface areas and metallic surface areas.

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[Background Information

] BACKGROUND INFORMATION

The use of ceramic (glass ceramic) hybrid substrates is [known] conventional, for example [for], in the construction of electrical circuit arrangements. Such electrical circuit arrangements are used in various industrial areas, for example, in the area of motor vehicle electronics for engine control, anti-lock braking control, [or the like] etc. The ceramic hybrid substrates contain processed electronic components and metallic conducting tracks, via which contacting of the hybrid substrates can occur. It is [known] conventional that such ceramic hybrid substrates are obtainable by laminating individual function layers [which] that may have electrical connecting leads, integrated circuit constituents, micromechanical structures [or the like], etc. Such a sandwich arrangement that includes several function layers is subsequently sintered so that the finished ceramic hybrid substrate is formed. The finished ceramic hybrid substrate therefore has a surface structure that includes some ceramic surface areas and some metallic surface areas (conducting tracks, pads) embedded in them. By miniaturizing such ceramic hybrid substrates, the distance between adjacent metallic areas can be in the range of $< 100 \mu\text{m}$. In order to be able subsequently to contact such metallic surface areas integrated in the so-called fine line technology, for example, by bonding, the application of electrically conductive

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adhesives, [or the like] etc., it is [known] conventional that the metallic surface areas can be finished, for example, by applying a contact metal (silver, gold, or the like) to the metallic surface areas using a chemical deposition process. In this case, the ceramic hybrid substrates are treated in chemical baths, some of which contain aggressive and etching substances [which] that attack the surface of the ceramic surface areas. Moreover, it is disadvantageous that, during the deposition of the contact metal in chemical baths, deposits of metals can also occur on the ceramic surface areas which can - in particular in view of the small distances between the metallic surface areas - result in short circuits. Moreover, it is disadvantageous that during a subsequent contacting of the metallic surface areas, for example, by an electrically conductive adhesive, the adhesive tends to flow (bleed), so that short circuits can [likewise] occur between adjacent metallic areas.

[Summary of the Invention

] SUMMARY

In contrast, the method according to the present invention [having the features as recited in the preamble of Claim 1] and the ceramic hybrid substrate according to the present invention [having the features as recited in the preamble of Claim 16 offer] provides the advantage that a subsequent machining of the metallic surface areas or a subsequent contacting of the metallic surface areas may [take place] occur, with a reduced tendency [to] of short circuits between adjacent metallic surface areas. By esterifying the ceramic surface areas of the ceramic hybrid substrate, [it is advantageously achieved that] the ceramic surface areas [are] may be protected selectively during the subsequent post-treatments in chemical baths. As a result of the esterification, a monomolecular surface layer is formed on the ceramic surface areas which is resistant to chemicals and

heat, so that metal coatings chemically deposited in particular on the metallic surface areas are not able to deposit on the ceramic surface areas. Moreover, this selective esterifying of the ceramic surface areas causes a change in their surface tension, so that electrically conductive adhesives applied to the metallic surface areas do not tend to flow onto the ceramic surface areas.

The surface of the ceramic hybrid substrate [is preferably] may be treated with a solution [having] including organic constituents tailored to the ceramic surface. This treatment [preferably takes place] may occur via a dipping bath, flow wave soldering, spraying on, spreading on with a doctor, [or the like] etc. By wetting the surface with the solution [having] including the organic constituents, the solution is deposited in micropores of the ceramic surface areas. Via a [preferably provided] subsequent heat treatment, crosslinking of the organic constituents of the solution with lattice structures on the ceramic surface areas [takes place] may occur. This results in the formation of the chemically and thermally stable (resistant) surface coating of the ceramic surface areas. By a subsequent removal of non-crosslinked residues of the solution [having] including the organic constituents [preferably provided], the solution [is] may be removed from the metallic surface areas, where no adhering effect (crosslinking) [takes place] occurs. The metallic surface areas in the processed form and with the original properties are thus available for further processing.

[A preferred use of the] An example method according to the present invention [is] may be used for ceramic hybrid substrates whose manufacture is silicon-based, in which the ceramic surface areas [is] are treated with silicon as a solution containing an organic component (siloxane). The concentrations of organic silicon compounds [are preferably]

may be between 0.1 and 1% of the solution - relative to the total volume. Using such a treatment, a silicon oxide or silicon dioxide surface layer that has good resistance to chemical and thermal influences may be achieved after the crosslinking of the solution with the ceramic surface areas.

[Further preferred developments of the present invention appear from the other features recited in the subclaims.

Brief Description of the Drawing

The present invention is explained in more detail below with reference to exemplary embodiments illustrated in the related drawing.]

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 [through] to 3 [show] illustrate various phases of the treatment of the ceramic surface areas[and].

Figures 4 and 5 schematically [show] illustrate the esterification of the ceramic surface areas.

[Detailed Description of the Exemplary Embodiments

] DETAILED DESCRIPTION

In Figures 1 [through] to 3, a ceramic hybrid substrate 10 (LTCC microhybrid substrate) is [shown] illustrated schematically. Ceramic hybrid substrate 10 [has] includes ceramic surface areas 14 and metallic surface areas 16 on its surface 12. Metallic surface areas 16 may, for example, be bonding pads, adhesive pads, [or the like] etc. The processing of such ceramic hybrid substrates 10 is generally [known] conventional, so that further details of this will not be further explained [within the bounds of the present description].

[The] An example method according to the present invention for achieving a surface improvement of ceramic surface areas 14 is explained below.

5 First, as [indicated] illustrated in Figure 1, surface 12 is acted upon by a solution 18 having organic components. Solution 18 may act, for example, via a dipping bath, spraying on, flow wave soldering, [or the like] etc. This results in solution 18 being deposited on ceramic surface areas 14 and
10 metallic surface areas 16. Excess quantities of solvent are removed mechanically, for example, by wiping off, blowing off, centrifuging, [or the like] etc. This results in the formation of a thin layer of solution 18 on the entire surface 12, i.e., on ceramic surface areas 14 and metallic surface areas 16.
15 Solution 18 adheres to surface 12 by surface [tensions] tension and penetrates surface pores.

Solution 18 includes, for example, a 0.1% siloxane solution.

20 Figure 4 shows a ceramic surface area 14 of ceramic hybrid substrate 10 in section. Ceramic hybrid substrate 10 is made, for example, of a silicon glass ceramic. Such silicon glass ceramics have reactive groups (OH groups). Wetting with solution 18, which [in the specific exemplary embodiments
25 contains] may contain silanes as organic components, is also [shown] illustrated in Figure 4.

Subsequently, a heat treatment of ceramic hybrid substrate 10 [takes place] occurs, for example, at a temperature of about
30 100°C and for a period of about 30 minutes. This results in a silanization (etherification) of ceramic surface areas 14. The resulting crosslinking is [shown] illustrated in Figure 5. Silicon attaches itself to the reactive groups, forming an Si-O-Si structure. Such silicon structures, as is [known]
35 conventional, excel by their chemically and thermally stable

properties. Free hydroxyl groups (OH groups) as reactive groups react with the silicon-containing educt, resulting in the formation of the Si-O-Si bond (siloxanes).

5 Then, as [shown] illustrated in Figure 2, residual quantities 18" of solution 18 not crosslinked with ceramic surface areas 14 are removed.

10 This removal [is preferably] may be implemented by washing off with a solvent, for example, isopropanol. This results in the surface coating of ceramic surface areas 14 with silicon components 18' [shown], as illustrated in Figure 3. Metallic surface areas 16 do not react with the organic components, so that [they] are unchanged after residual quantities 18" have
15 been detached chemically and mechanically.

Thermal decomposition of organic component R₁ may [take place] occur via a subsequent baking procedure, so that a silicon dioxide layer is formed in ceramic surface areas 14, as
20 indicated in the lower structural representation in Figure 5.

As a result of the method according to the present invention, ceramic hybrid substrate 10 [has] includes ceramic surface areas 14 that have a high chemical stability against etching
25 attacks occurring in the subsequent manufacturing process. In particular, defective depositions on ceramic surface areas 14 situated between metallic surface areas 16 may be avoided with a subsequent deposition of metals, for example [of], silver, nickel, palladium, gold, [or the like] etc., on metallic
30 surface areas 16. Thus the danger of short circuits is reduced. Moreover, the surface tension of ceramic surface areas 14 is changed, such that electrically conductive adhesives applied to metallic surface areas 16 do not tend to flow, so that the formation of bridges [or the like], etc.

between adjacent metallic surface areas 16 is likewise considerably reduced.

[The] A modification of ceramic surface areas 14 provided according to the present invention may be integrated into the total manufacturing process of the circuit arrangement [having] including ceramic hybrid substrates 10, to produce various process advances. According to a first example embodiment variant, silanization of ceramic surface areas 14 [takes place] occurs after the manufacture of ceramic hybrid substrate 10 [shown], as illustrated in Figures 1 to 3, i.e., before subsequent thick-film processes, baking processes, plating processes, provision of substrate 10 with conductive adhesives, bonding, [or the like] etc. In particular, a protective coating of ceramic surface areas 14 against chemical attacks in the chemical baths during plating (deposition of metals on metallic surface areas 16) is achieved [here].

According to [a further] another variant example embodiment according to the present invention, the silanization of ceramic surface areas 14 may [take place] occur after the thick-film processes and baking processes. Silanization may then [take place] occur before plating, conductive adhesive processes, or bonding. This results in the same advantages as in the first example embodiment variant.

[Finally, silanization] Silanization of ceramic surface areas 14 may also [take place] occur after plating (metallization) of metallic surface areas 14. However, this does not provide a protective coating against the action of the chemical baths on ceramic surface areas 14. However, during a subsequent provision of substrates 10 with electrically conductive adhesives or bonding, for example, the flow of the adhesives is reduced by influencing the surface tension.

Depending on the desired processing, siloxanization of ceramic surface areas 14 may thus be incorporated at various points in time during processing.

[Abstract

] ABSTRACT

[A] In a ceramic hybrid substrate and a method for treating
the surface of a ceramic hybrid substrate having ceramic
5 surface areas and metallic surface areas [is described.

The], the ceramic surface areas [(14)] are esterified. [

10 (Figure 4)]